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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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Development of USES Aptitude Test Battery for Inspector, Assemblies And Installations

(aircraft mfg.) 806.381

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U.S. DEPARTMENT OF LABOR
MANPOWER ADMINISTRATION

Technical Report on Development of USES Aptitude Test Battery

For . . . . .

Inspector, Assemblies and Installations (aircraft mfg.) 806.381

S-404

(Developed in Cooperation with the
Washington State Employment Service)

U.S. DEPARTMENT OF LABOR
Willard Wirtz, Secretary

BUREAU OF EMPLOYMENT SECURITY
Robert C. Goodwin, Administrator

MANPOWER ADMINISTRATION
Stanley H. Ruttenberg,
Administrator

U.S. EMPLOYMENT SERVICE
Charles E. Odell,
Director

February 1968

FOREWORD

The United States Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

Charles E. Odell, Director
U.S. Employment Service

GATB Study #2673

DEVELOPMENT OF USES APTITUDE TEST BATTERY

for

Inspector, Assemblies and Installations
(aircraft mfg.) 806.381-026
S-404

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Inspector, Assemblies and Installations (aircraft mfg.) 806.381-026. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
G - General Learning Ability	100
Q - Clerical Perception	95
K - Motor Coordination	80

RESEARCH SUMMARY

Sample:
81 male trainees in an MDTA course for Inspectors, Assemblies and Installations, at Highline College, Auburn, Washington.

Criterion:
Course grades

Design:
Longitudinal (tests were administered before training and criterion data were collected at the end of training).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations and selective efficiencies.

Predictive Validity:
Phi Coefficient = .47 ($P/2 < .0005$)

Effectiveness of Norms:
Only 74% of the nontest-selected trainees used for this study were good trainees; if the trainees had been test-selected with the S-404 norms, 88% would have been good trainees. 26% of the nontest-selected trainees used for this study were poor trainees; if the trainees had been test-selected with the S-404 norms, only 12% would have been poor trainees. The effectiveness of the norms is shown graphically in Table 1;

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Trainees	74%	88%
Poor Trainees	26%	12%

SAMPLE DESCRIPTION

Size:
N = 81

Occupational Status:
MDTA trainees

Training Facility:
Eleven 12-weeks MDTA courses for Inspector, Assemblies and Installations, at Highline College, Auburn, Washington. The instructors were experienced inspectors.

MDTA Selection Requirements:
Education: High school graduate or equivalent education
Previous Experience: None required
Age: 18 years or older
Tests: None
Other: Selection interviews by ES local office personnel

Principal Activities:
The job duties of the occupation, and the subjects contained in the course of study are shown in the Fact Sheet in the Appendix.

Minimum Experience:
All trainees in the sample were tested prior to enrollment in the course.

TABLE 2

Means (M), Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age and Education.

	Mean	SD	Range	r
Age (years)	26.7	8.2	17-53	-.17
Education (years)	11.5	2.7	11-14	.08

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002 A, were administered to the sample between January 1965 and May 1966. The Form A was used because many potential trainees had been tested in the previous three years. If the Form B had been used in retesting them, the retests would have resulted in spuriously high aptitude scores and test battery norms.

CRITERION

The criterion consisted of class grades which were assigned by the training faculty. The trainees in the first eight classes were graded on 8 areas related to inspection while trainees in the last three classes were graded on 4 areas related to inspection. The four areas were obtained by combining some of the 8 areas. The class grades on each course area were converted to numerical scores. These numerical scores were adjusted so that they were equal to their proportion of class time to total class time. The final criterion consisted of the totals of the adjusted numerical scores for the course areas related to inspection and its back-ground.

Reliability:

Since the training facility had only retained final grades, the reliability could not be determined.

Criterion Score Distribution:

Possible Range :	30.9 - 67.8
Actual Range :	33.4 - 64.2
Mean :	50.2
Standard Deviation :	7.0

Criterion Dichotomy:

The training staff believed between 20 and 30 percent of the trainees completing training would be unsatisfactory or marginal inspectors. Based on this information, the criterion distribution was dichotomized into low and high groups by placing 25.9 percent of the sample in the low group. This is slightly above a C grade. Trainees in the high criterion group were designated as "good trainees" and those in the low group as "poor trainees." The criterion critical score is 46.30.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Tables 3, 4, and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the course analysis, the aptitudes indicated appear to be important to the course which was based on job requirements)

Aptitude	Rationale
V - Verbal Aptitude	Comprehension of instructions, manuals and specifications; preparation of inspection reports and rejection tags.
S - Spatial Aptitude	Reading blueprints and visualizing the part in three dimensions.
P - Form Perception	Observe cracks, flaws, corrosion, burns, damaged finish; comparison of a part with a standard part.
Q - Clerical Perception	Reading gages and testing instruments accurately

TABLE 4

Means (M), Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB: N = 81

Aptitudes	Mean	SD	Range	r
G - General Learning Ability	109.7	12.3	78-150	.561**
V - Verbal Aptitude	105.1	11.9	76-131	.434**
N - Numerical Aptitude	106.1	11.8	80-135	.491**
S - Spatial Aptitude	111.0	18.5	51-166	.223*
P - Form Perception	110.2	17.2	44-153	.282*
Q - Clerical Perception	109.5	13.7	81-147	.288**
K - Motor Coordination	101.7	18.0	58-153	.299**
F - Finger Dexterity	98.0	20.5	45-158	.112
M - Manual Dexterity	107.7	20.1	55-152	.130

*Significant at the .05 level
**Significant at the .01 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important		X		X	X	X			
Irrelevant									
Relatively High Mean	X			X	X	X			
Relatively Low Standard Dev.	X	X	X			X			
Significant Correlation with Criterion	X	X	X	X	X	X	X		
Aptitudes to be Considered for Trial Norms	G	V	N	S	P	Q	K		

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of aptitudes G, V, N, S, P, Q, and K at trial cutting scores were able to differentiate between the 74% of the sample considered good trainees and the 26% of the sample considered poor trainees. Trial cutting scores at five point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample; for four-aptitude trial norms, minimum cutting scores of slightly less than one standard deviation below the mean will eliminate about one third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. The optimum differentiation for the occupation of Inspector, Assemblies and Installations 806.381-026 was provided by norms of G-100, Q-95, and K-80. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .47 (statistically significant at the .0005 level).

TABLE 6

Predictive Validity of Test Norms, G-100, Q-95, K-80

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Trainees	9	51	60
Poor Trainees	14	7	21
Total	23	58	81

Phi Coefficient (ϕ) = .47 Chi Square (χ^2) = 18.0

Significance Level = $P/2 < .0005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-36 which is shown in Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .20 is obtained with the OAP-36 norms G-105, Q-100 and K-90.

Job Title: Inspector, Assemblies and Installations (aircraft mfg.) 806.381-026

COURSE DESCRIPTION

Course Summary: The primary purpose of the course was to instruct trainees in inspection procedures and use of appropriate measuring instruments. The trainees made practice assemblies involving various assembly procedures and techniques to become familiar with how and where errors occur. This gave them practice on physical units comparable to aircraft material and components.

Course Outline

Subject	Hours
I. Blueprint Reading	75
A. Introduction	
B. Applied Geometry	
C. Pictorial Sketching	
D. Orthographic Projection	
E. Aircraft Drawings	
1. Sheet 1	
2. Dimensioning and Tolerancing	
3. Use of Standards and Specifications	
4. Installation Drawings	
5. Production Illustration Drawings	
II. Mechanic Familiarization	25
A. Introduction and Shop Safety	
B. Hand Tool Familiarization	
1. Inspection and Mechanical Tools	
C. Power Tool Familiarization	
D. Use of Drawings and Specifications	
E. Detail Part Fabrication	
1. Use of Drawings	

2. Layout

3. Drilling and Reaming

F. Assembly Procedures and Practice

G. Installation Procedures and Practice

H. Inspection Procedures and Practice

III. Basic Mathematics Review 20

A. 1 Hour a Day first 4 weeks

IV. Tooling Familiarization 62

A. Shop Math (Trigonometry)

B. Tooling Procedures

1. Manuals and Specifications

2. Nomenclature

3. Drawings

4. Work Orders

C. Precision Tools

1. Uses of Tools

2. Surface Plate Setups

3. Templates

D. Plaster Models

E. Plant Tour

V. Inspection Techniques 87

Thorough Coverage of:

A. Standards -- AN, BAC, NAS, MS, Etc.

B. Process Specifications

C. Documents

D. Operating Procedures

E. Quality Control Manual D6-1979

1. Responsibilities of Inspectors

VI. Elements of Inspection 172

A. Introduction

B. Quality Control Manual (D6-1979)

1. Inspection Forms

a. Rejection Tags

b. Pickup Card

c. Standard Repair

d. Special Repair

e. Removal Record

2. Stamps and Symbols

C. Aircraft Materials and Finishes

D. Fabrication Inspection

1. Hardness Testing

a. Rockwell

b. Barcol

c. Forming and Fitting Metal Parts

E. Statistical Quality Control

F. Use of Drawings and Specifications

G. Precision Measuring

H. Subassembly Inspection Methods

1. Use of Pickups

2. Use of Rejection Tags

3. Dye Check Procedures

I. Final Assembly Inspection

1. Structures

2. Systems

3. Final Shakedowns

4. Closures

VII.	General Behavior	31
	A. Human Relations	
	B. Communications	
	C. Quality Concepts	
	D. Motivations	
	E. Goals	
VIII.	Plant Tour	8
		480 Hours

FACT SHEET

Job Title: Inspector, Assemblies and Installations (aircraft mfg.) 806.381-026

Job Summary:

Inspects materials, parts, assemblies, tools, templates, jigs, components and installations using scales, calipers, gages, micrometer and other appropriate measuring instruments to determine compliance with specifications, quality standards, and tolerances from blueprints, drawings and manual requirements.

Work Performed:

Inspects such fabricated detail parts (visually and dimensionally) as flat detail parts, parts having angular flanges or breaks, parts that can easily be inspected to templates, drill fixtures and other tools.

Inspect parts, materials and assemblies for cracks, flaws, corrosion, burns, damage, hardness and finishes (anodic, plate, paint, dope and other protective and decorative finishes).

Inspect parts, tools and assemblies which are to be, are in the process of being, or have been welded or brazed by any welding, brazing and/or other assembly processes where the inspection may be accomplished by checking to samples, jigs or fixtures.

Inspects templates having straight brakes, and/or straight dimensional templates involving single plane application and/or straight dimensional templates having straight or radial profiles. Perform periodic inspection on existing assembly jigs as specified in established control procedures. Perform alignment checks on aircraft structures.

Inspects structural assemblies, components and installations for workmanship and applies proper acceptance or rejection designation as required to insure quality standards for such typical mechanical functions as drilling, reaming, countersinking, riveting, bolting; connecting of plumbing fittings, proper clearances and clamping of various system runs including electrical; installation of parts in jigs and the location of units and brackets within assemblies.

Effectiveness of Norms:

Only 74% of the nontest-selected trainees used for this study were good trainees, if the trainees had been test-selected with S-404 norms, 88% would have been good trainees. 26% of the nontest-selected workers used for this study were poor trainees; if the trainees had been test-selected with S-404 norms only 12% would have been poor trainees.

Applicability of S-404 Norms:

The aptitude test battery is applicable to jobs which include a majority of the duties described above.

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